INVESTIGATION OF STRENGTH CHARACTERISTIC OF GABION WALL MADE FROM GRAVEL MIXED WITH TYRE CHIPS

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SUPERVISOR'S DECLARATION

I/We* hereby declare that I/We* have checked this thesis/project* and in my/our* opinion, this thesis/project* is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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EFFECTIVENESS OF TYRE CHIPS AS ALTERNATIVE MATERIAL IN VERTICAL GABION WALL TO MITIGATE SLOPE FAILURE

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ABSTRAK

Untuk mengurangkan penimbunan tayar sisa dengan menggunakannya sebagai bahan gantian untuk dinding gabion, keberkesanan penggantian hendaklah disiasat. Objektif utama kajian ini adalah untuk mengkaji sifat kekuatan dinding gabion yang diperbuat daripada batu yang bercampur dengan cip tayar. Beberapa ujian menggunakan cerun dan model dinding gabion dengan hujan tiruan telah dilaksanakan. Dinding gabion disusun secara menegak. Lereng dengan 60 ° kecerunan tanpa dinding gabion atau sokongan diuji terlebih dahulu. Cerun gagal apabila tertakluk kepada hujan 570mm / hr pada minit kedua. 100% batu dan 100% cip tayar dinding gabion diletakkan dan disusun secara menegak di lereng dalam ujian berasingan. Tiada anjakan dinding yang dikesan. Ini bermakna dinding gabion dengan 100% cip tayar sudah memberikan sokongan yang mencukupi untuk mengelakkan dari kegagalan cerun berlaku. Untuk memastikan kebenaran dinding gabion dengan 100% cip tayar boleh memberi sokongan yang mencukupi, dinding gabion dengan 50% batu dan 50% cip tayar diuji pada dimensi cerun yang sama. Tiada anjakan berlaku selepas hujan. Oleh itu, kesimpulan yang dapat dibuat adalah menggantikan batu dengan tayar buangan sebagai bahan untuk dinding gabion boleh digunakan pada projek yang berskala kecil.

ABSTRACT

In order to reduce stockpiling of waste tyre by use it as a replacement material for gabion walls, the effectiveness of the replacement must be investigated. The main objectives of this study were to investigate the strength characteristic of gabion wall made from gravel mixed with tyre chips. Series of test using a slope and gabion walls model with artificial rainfall were conducted. The gabion walls were arranged in vertical order. A 60° slope without any retaining wall or support was tested first. The slope failed when subjected to 570mm/hr rainfall after two minutes. 100% of gravel and 100% tyre chips gabion walls placed and stacked in vertical order at the slope in separate test. There was no displacement of gabion wall detected. This means 100% tyre chips already provide sufficient support to prevent from slope failure happen. To ensure the truth of 100% tyre chips gabion walls can provide sufficient support, 50% gravel and 50% tyre chips gabion walls was tested at the same slope dimension. There was also no displacement occur after subjected to rainfall. Because of that, it can be concluded that replacing gravel with waste tyre as a material in gabion wall can be applied in a small scale project.

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LIST OF SYMBOLS

γ_d	Dry Density
γ	Bulk Density
ω	Water Content
C_u	Coefficient of Uniformity
C_c	Coefficient of Gradation
G_s	Specific Gravity
%	Percentage

CHAPTER 1

INTRODUCTION

1.1 Background of study

In Malaysia, the rains are heavy in November and December. Therefore, many slope failure cases happens during both months. Slope instability can endanger human's life, buildings and roads. Besides, causing the government to bear high maintenance's cost and other costs. Besides that, tyre waste cause many bad impacts on the environment.

A landslide happens in Cameron Highlands on 26 November 2014. This accident happen after a heavy rain. One of the methods to prevent slope failure is by placing gabion wall. In current practice, a gabion is made from 100% gravel assembled together in a wire mesh

In this study, the effectiveness of using new material such as tyre chips to replace gravel is studied. Which percentage of tyre chips that show the most effective strength characteristic of the gabion wall.

To achieve the objective, numerical simulation is conducted to obtain the critical dimensions. Before performing numerical simulation, basic properties test of material is conducted to use as a parameters required for numerical simulation. Next, several slope model and gabion wall is built according to dimension obtained from numerical simulation. The slope model is subjected to artificial rainfall. The displacement of gabion wall and erosion occur due to rainfall will be recorded.

1.2 Problem statement

In Malaysia, heavy rainfall usually happened in the month of November and December. Heavy rainfall caused many disaster and failure that can endanger human's life, buildings and roads. A common disaster that usually happened during these months is slope failure. Slope failure case normally occurred after prolonged rainfall. When slope failure occurred, it caused many losses and damages especially when the slope located near roads or residential area. It also caused the government to bear all maintenance cost and other costs to restore all the damages. Slope failure also have been acknowledged as one of the disaster that can lead to great losses and costs to a government to recover what have been damaged.

On the other hand, amount of stockpiling of waste tyre have been increasing every year due to the increasing number of cars on roads. Tyres waste which are conventionally dumped can caused various pollutions due to it is difficult to decompose and compact. It also can cause growth of dangerous pests and insects such as mosquito which can carry dengue, zika, and yellow fever. Besides, tyre can take up landfill space due to its hollow shape and cause landfill to full in a short time. In other countries, various recycle method of used tyres have been practiced. However, it also can cause many disadvantages. There are many waste tyres recycling alternatives method. For example, some country had made a tyres waste power plant. Although tyres make good burning material, unfortunately it polluted the air because of hazardous compound and toxic gases produced when burning them which is harmful to humans and environment by leaving oily residue. It also releases tremendous number of small particles that can settle deep in the lungs when inhale the air which are contaminated. This usage of this method of recycling need to be reduced.

Moreover, source of gravel had been used widely in construction. Quarry industry also need to maximize the production due to many housing developments and townships had to expand and grow. Because of that, source of gravel maybe limited someday in the future. To overcome all those problems stated, the effectiveness of using new material which is tyre chips as part of material to make gabion walls to increase slope stability was studied.

1.3 Objective of study

The objective investigation on the effectiveness of gabion wall made from gravel mixed with tyre chips is:

1. To obtain the basic properties of soil and tyre chips.
2. To determine the effectiveness of tyre chips and gravel as a material for gabion wall that give best result in stability slope.

1.4 Scope of study

The study focus on making a slope model and determination of basic properties of material that used in the study. Laboratory tests were conducted to obtain basic properties of material that ben used in making slope model. Laboratory test that were conducted are sieve analysis, shear strength test, specific gravity test and permeability test. Next, six slope model and six gabion wall with different percentage of tyre chips was built according to dimension obtained from numerical simulation. An artificial rainfall was also simulated.

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